NAME (from your UF ID): _____ **UF ID#:** _____

(Please **PRINT**)

--------------------------- CEN 4072/6070 Software Testing & Verification ------------------------

Quiz 5 -- Spring 2017

You have 30 minutes to work on this quiz. It is a "closed-book/closed-notes" test. Pay attention to point values, since you may not have time to work all 3 problems.

PRINT your name and UF ID# above NOW and sign the pledge at the bottom of this page, if appropriate, when you are finished.

PLEASE PRINT **– do NOT write *cursively* –** ANSWERS IN THE SPACE PROVIDED ONLY – **NOT IN THE MARGINS** – PREFERABLY USING A BALLPOINT PEN TO INCREASE LEGIBILITY. Good luck!

1. (9 pts.) Given P, f_1, f_2, and f_3:

$$P = \text{if } x>=y \text{ then } x:=x+y; \; y:=x-y; \; x:=x-y \text{ end-if}$$
$$f_1 = (x \neq y \to x,y := y,x)$$
$$f_2 = (x>y \to x,y := y,x \mid x<y \to I)$$
$$f_3 = (x>y \to x,y := y,x \mid \text{true} \to I)$$

Determine the correctness relationships between the given program, P, and functions. In the table below, indicate "C" for Complete program correctness, "S" for Sufficient program correctness only, and "N" for Neither. To *partially* compensate for random guessing, you will receive +3 pts. for each correct answer given and -1 pt. for each incorrect answer given, with a minimum possible score of 0 pts.

	P
f_1	
f_2	
f_3	

2. (5 pts.) Consider the following program P:

```
y := x*y;
if y>0 then
   x := x+y
else
   x := x-y
end_if_else
y := 3
```

Which one of the following is $[P]$? (Circle ONE only.)

a. $(x>0 \to x,y := 4x,3 \mid x \leq 0 \to x,y := x-3y,3)$

b. $(xy>0 \to x,y := 4x,3 \mid xy \leq 0 \to x,y := x-3y,3)$

c. $(xy>0 \to x,y := x+xy,3 \mid \text{true} \to x,y := xy-x,3)$

d. $(xy>0 \to x,y := x+xy,3 \mid xy<0 \to x,y := x-xy,3 \mid \text{true} \to x,y := x,3)$

e. $(y>0 \to x,y := x+y,xy+y^2) \mid y \leq 0 \to x,y := x-y,xy-y^2)$

f. (none of the above)

3. Suppose you were asked to prove that the program K,

$$K:\ \text{while } y<>0 \text{ do}$$
$$x := x+1;$$
$$y := y-1$$
$$\text{end\_while}$$

computes the function f,

$$f = (y \geq 0 \rightarrow x,y := x+y,0)$$

by showing that each of the following correctness conditions hold:

(1) term(f,K),

(2) $p \Rightarrow (f=f\circ g)$, and

(3) $\neg p \Rightarrow (f=I)$.

a. (2 pts.) Express "g" as a single concurrent function in terms of variables x and y?

b. (2 pts.) What are "p" and "$\neg p$" from correctness conditions (2) and (3) above? (Give the actual expressions that p and $\neg p$ represent.)

p: _____ $\neg p$: _____

c. (3 pts.) Assume that you wish to use the Method of Well-Founded Sets to prove term(f,K).

i. Give a simple "measure" that could be used when applying this method with K.

measure: _____

ii. For what range of possible initial values of the measure would the proof be relevant?

iii. By what value would the measure be "bounded" – i.e. what would be the last possible value of the measure given the range of initial values identified in part (ii) above?

3. d. (7 pts.) Prove that correctness condition (2) holds. Show and explicitly justify all steps and cases as illustrated in class, supplied problem solutions, etc. (Hint: there are TWO separate cases to prove.)

Proof that $p \Rightarrow (f=f \circ g)$: